# ATTACHMENT 4: PROJECT DESCRIPTION

## Detailed Project Description

Limited water supplies in Olympic Valley have resulted in a perceived competition between water needed for municipal and irrigation supplies and water needed for environmental sustainability. One factor that led to the limited water supply is the channelization of Squaw Creek in the late 1950s by the Army Corp of Engineers. This channelization replaced the naturally meandering Squaw Creek with a deep, straight channel that is locally known as the trapezoidal channel, shown on Figure Att4-1. The trapezoidal channel improved drainage, but resulted in the unintended consequence of draining shallow groundwater away from the aquifer. This resulted in two problems; first the trapezoidal channel quickly depletes the available water for in-stream flows much earlier in the season than a natural creek bed would, and secondly the channel drains water away from the well field reducing the available water in the aquifer for water supply.

The Olympic Valley Creek/Aquifer Interaction Project Phase I was initiated in response to the State Water Resources Control Board's Resolution No. 2007-0008, which resolved to direct the Lahontan Regional Water Quality Control Board (RWQCB) to continue to support the efforts of entities pumping groundwater as well as other stakeholders in Olympic Valley to: (1) minimize effects on the creek, (2) develop a groundwater management plan that recognizes potential effects of pumping on the creek and seeks to minimize or eliminate adverse effects on Squaw Creek, and (3) conduct a study of potential interaction between groundwater pumping and flows in Squaw Creek. Phase I was a well installation and data collection phase which has been completed. Phase II is now required to assess and evaluate the data collected in Phase I, and to implement the results in tools that will assist stakeholders with groundwater and creek management.

The Olympic Valley Creek/Aquifer Interaction Project Phase II will implement scientifically based guidelines for cooperatively managing the limited water resources and mitigating the unintended consequences of the trapezoidal channel. The project will quantify the impact of groundwater pumping on stream flows in Squaw Creek and the impact of the trapezoidal channel. Phase II will furthermore minimize future pumping impacts to Squaw Creek and increase the amount of water that could be stored in local aquifers by developing and implementing different stream and/or pumping management strategies. Overall, the project will advance water supply reliability, promote groundwater storage, promote fisheries restoration and protection, and address impacts from anticipated climate change.

Depth specific temperature data collected from the streambed will be used as a tracer to track the movement of water between Squaw Creek and the underlying groundwater system. The method is based on quantifying changes in phase and amplitude of temperature variations between pairs of subsurface sensors set below the streambed. The results of this analysis will enable us to quantify creek/aquifer interactions along a key stretch of the trapezoidal channel, alongside the primary production wells in the basin. The aquifer test data will be analyzed using standard hydrogeologic techniques such as Theis analyses, Cooper-Jacob analyses, and

Hantush leaky-aquifer analyses. These analyses will be used to estimate the aquifer's hydraulic properties such as transmissivity, storage, and leakance from the aquifer tests. The aquifer test data analyzed in conjunction with stream data will be used to establish pumping impacts on Squaw Creek. The above analyses will be integrated with LLNL climate change and tracer study data for Olympic Valley (Singleton and Moran, 2010). Tracer data will be interpreted to identify locations of groundwater inflow and to quantify groundwater inflow to Squaw Creek during the time period over which the tracer sampling took place in 2009. Interpretation of integrated results will center on seasonal creek/aquifer interaction, groundwater recharge, and the effects of climate change (higher snowline, more precipitation as rain) on runoff, groundwater recharge, and the water budget for the basin.

A groundwater flow model developed in 1999 for Olympic Valley will be updated based on the results of the depth specific temperature data, results of the aquifer test analysis, and findings of the LLNL tracer study. Integrating these results with the Olympic Valley groundwater flow model will allow the model to accurately predict seasonal interactions between shallow aquifers and Squaw Creek, and the impact of pumping on Squaw Creek flows. The model can then be used to establish groundwater management guidelines that minimize pumping impacts on Squaw Creek and maximize groundwater storage in the basin. Apart from using the model to answer some immediate questions, it will be used as an ongoing tool to manage the basin with respect to climate change and increased development.

The final product of the project will be a document that implements objectives of both the Tahoe Sierra Integrated Regional Water Management Plan and the Olympic Valley Groundwater Management Plan. Pumping and stream management guidelines for different climate and hydrologic conditions will be developed with the overall goal of maximizing aquifer storage and minimizing stream impacts.

Well permitting, well installation, monitoring equipment purchase and installation, aquifer testing, and data collection were all completed in Phase I. A CEQA categorical exemption was filed during Phase I, which covers the entire project, including all tasks and activities described in this grant application.

All necessary land use agreements were finalized during the previous project phase. The land use agreements were necessary for the well installation and data collection activities. The land use agreements remain in effect, and no additional land use agreements are needed for this phase.

A substantial quantity of data has been collected over the past four years to support the actions that will be taken for Phase II. These data will be used to quantify the creek/aquifer interaction dynamic that forms the basis of the proposed management actions. Data from Phase I of the Olympic Valley Creek/Aquifer Interaction Project collected over the previous four years include:

- Long-term groundwater level data from paired shallow and deep monitoring wells adjacent to Squaw Creek.
- Approximately eight months of shallow groundwater temperature data from eighteen sensors installed in six probes in Squaw Creek. These temperature data show the

seasonal interaction between the water in Squaw Creek and the shallow groundwater system.
- Groundwater level data collected from seven wells, four shallow piezometers, and eighteen temperature probes during a 53-hour aquifer test conducted while Squaw Creek was flowing.
- Groundwater level data collected from seven wells, four shallow piezometers, and eighteen temperature probes during a 52-hour aquifer test conducted while Squaw Creek was dry.
- Squaw Creek flow data.

Data previously collected by Lawrence Livermore National Laboratory (LNLL):

- In-stream temperature data along the middle reach of Squaw Creek.
- Geochemical data (dissolved Radon, major ions, and carbon isotopes)

## Project Goals

The project's goals are:

1. Improve and quantify our understanding of creek/aquifer interactions;
2. Improve the existing groundwater model to confidently simulate groundwater and stream interactions;
3. Diminish groundwater pumping impacts on Squaw Creek and the associated Truckee River; and
4. Increase groundwater storage in Olympic Valley.

## Needed Facilities and Locations

No new facilities are required for this project.

Figure Att4-2 shows the project location in relation to the areas water agencies/purveyors: Squaw Valley Public Service District (SVPSD) and Squaw Valley Mutual Water Company (SVMWC). Figure Att4-1 shows the location of the GWMP area and monitoring features that will be evaluated as part of this project.

## Supporting the Goals of the GWMP

The project implements actions that address many Basin Management Objectives (BMOs) in the *Olympic Valley Groundwater Management Plan* (Hydrometrics WRI, 2007), including:

- *BMO 1-1: Maintain groundwater supplies sufficient to provide water for current and future domestic, municipal, commercial, private, and fire protection uses during summer and autumn of the second consecutive year of low rainfall.* The project develops pumping management strategies that help ensure adequate water supplies. Additionally, the improved groundwater model will be an important tool for predicting and assuring future groundwater supplies

- *BMO 1-2: Minimize drawdown and maximize use of basin storage*. The pumping management strategies produced during this project will address this specific objective, providing management options to best achieve optimal storage conditions.
- *BMO 2-1: Comply with existing water quality standards.* The water quality of Squaw Creek is influenced by the amount and sources of water it receives. Shallow groundwater is one of those components. Understanding creek/aquifer interactions will improve our ability to manage the shallow aquifer contribution to the creek and thus its water quality.
- *BMO 3-2: Promote viable and healthy riparian and aquatic habitats by avoiding or minimizing future impacts from pumping on stream flows.* The groundwater model will provide us with a tool to optimize groundwater pumping and minimize its impact on Squaw Creek's riparian and aquatic habitats.
- *BMO 3-3: Minimize future impacts from pumping on identified wetlands.* Wetlands associated with the meadow downstream of the trapezoidal channel will benefit from the management actions aimed to minimize creek impacts and increase groundwater storage.
- *BMO 3-4: Support ongoing stream restoration efforts as they relate to groundwater management.* This objective is the primary focus of this project. The analysis will quantify pumping impacts on Squaw Creek, allowing future pumping to minimize creek impacts. The updated groundwater model can furthermore be used to simulate various stream restoration options.

## Ongoing Use of Data

The updated groundwater flow model will be used for ongoing groundwater management of the basin. Examples of where it will be applied in the future include: planning new pumping locations and volumes taking into account impacts on Squaw Creek and basin storage, and evaluating potential stream modifications.

After the project is completed, stakeholders who want to use the model to evaluate changing groundwater pumping strategies will be responsible for funding those particular model runs. This use of the model is a certainty due to planned development in the valley. The current plan is for the model to be updated every three to four years, and this will be funded by Squaw Valley Public Service District.

## Collaboration with Stakeholders

The GWMP has a number of stakeholders who are active in groundwater management of the Olympic Valley. These stakeholders : Friends of Squaw Creek, Squaw Valley Mutual Water Company, Squaw Valley Ski Corporation, Lahontan Regional Water Quality Control Board, Resort at Squaw Creek, and PlumpJack Inn. The stakeholders have various groundwater interests in the valley: some are concerned with restoring Squaw Creek; others want to know how much they can pump without impacting the creek.

As part of the GWMP, a Technical Advisory Group (TAG) which has representatives from the stakeholders meets at least annually to spearhead and direct GWMP initiatives. This project

has been discussed and reviewed at these meetings. The TAG will meet semi-annully while the project is underway in order to keep all parties appraised and involved.

Information and documents generated from this project will be disseminated at SVPSD Board of Director meetings, GWMP TAG meetings where all stakeholders are represented, and through SVPSD's website where the public will have access to the reports. Hardcopies will also be made available at SVPSD's offices.

## References

Hydrometrics Water Resources Inc. 2007. Olympic Valley Groundwater Management Plan. Prepared for Squaw Valley Service District. May. http://www.svpsd.org/pdffiles/GMP%20Files/OV_GMP_Final_rev1_06-01-07.pdf

Singleton, M.J. and Moran, J.E. (2010) Dissolved noble gas and isotopic tracers reveal vulnerability of groundwater in a small, high elevation catchment to predicted climate changes. Water Resources Research doi: 10.1029/2009WR008718.

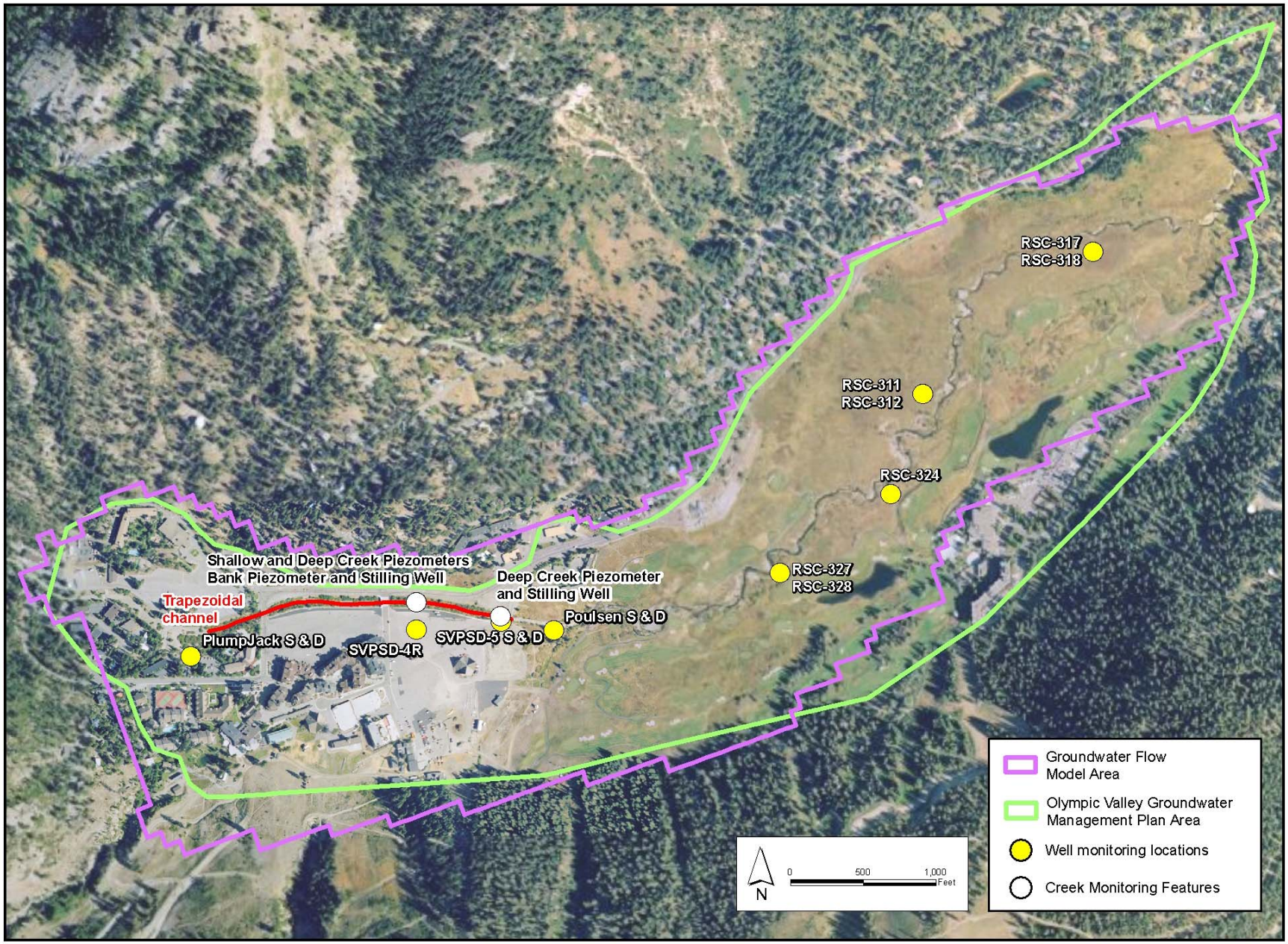


*Figure Att4-1: GWMP Area, Model Area, and Project Monitoring Features*

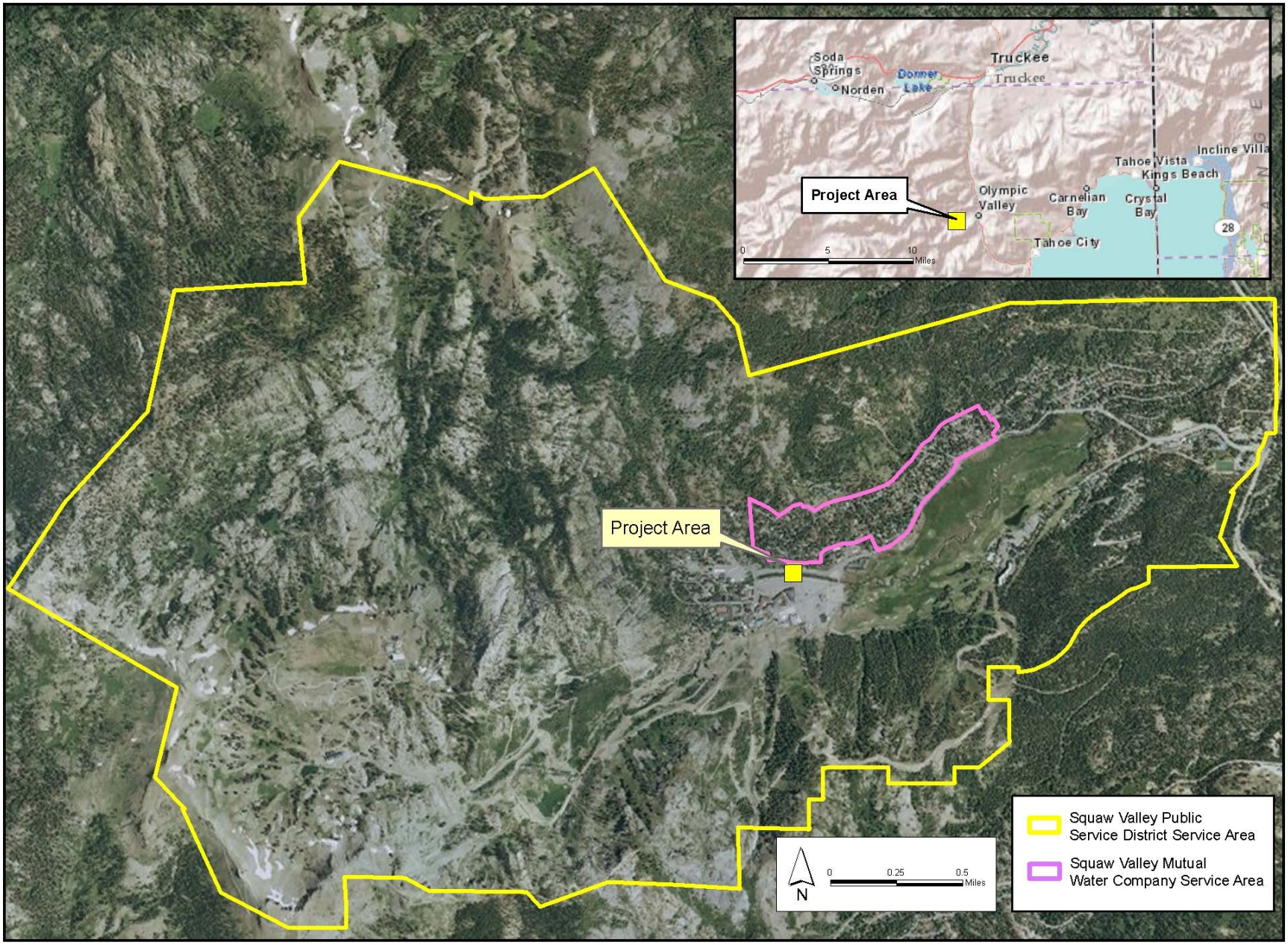


*Figure Att4-2: Project Location and Water Purveyor Boundaries*